

I CLAIM:

1. A liquid phase polymerization process for preparing a mid-range vinylidene content PIB polymer composition comprising PIB molecules, wherein a first portion of said PIB molecules have alpha position double bonds and a second portion of said PIB molecules have beta position double bonds, wherein said first and second portions together include at least 90% of the PIB molecules of the composition, wherein said first portion includes less than 70% of the PIB molecules of the composition, and wherein no more than about 10% of the PIB molecules of the composition have tetra-substituted internal double bonds, said process comprising:

providing a liquid feedstock comprising isobutylene;

providing a catalyst composition comprising a stable complex of BF_3 and a catalyst complexing agent, wherein the ratio of complexing agent to BF_3 in said complex is no more than about 1.3:1;

introducing said feedstock and said catalyst composition into a residual reaction mixture in a loop reactor reaction zone;

recirculating the residual reaction mixture in said zone at a recirculation rate sufficient to cause intimate intermixing of the residual reaction mixture, the feedstock and the catalyst composition to thereby present a recirculating, intimately intermixed reaction admixture in said reaction zone;

maintaining the recirculating intimately intermixed reaction admixture in its intimately intermixed condition and removing heat of reaction from the reaction admixture at a rate calculated to provide a substantially constant reaction temperature in the reaction admixture while the same is recirculating in said reaction zone;

withdrawing a product stream comprising said mid-range vinylidene content PIB polymer composition; and

controlling the introduction of said feedstock into said reaction zone and the withdrawal of said product stream from the reaction zone such that the residence time of the isobutylene components undergoing polymerization in the reaction zone is no more than about 4 minutes.

2. A process as set forth in claim 1, wherein said reaction temperature is at least about 60 °F.
3. A process as set forth in claim 1, wherein said agent is methanol.
4. A process as set forth in claim 2, wherein said agent is methanol.
5. A process as set forth in claim 4, wherein said residence time is no more than about 1 minute.
6. A process as set forth in claim 5, wherein said residence time is less than 1 minute.
7. A process as set forth in claim 4, wherein said mid-range vinylidene content PIB polymer composition in said product stream has a molecular weight in the range of from about 350 to about 5000.
8. A process as set forth in claim 7, wherein said mid-range vinylidene content PIB polymer composition in said product stream has a molecular weight in the range of from about 950 to about 1050.

9. A process as set forth in claim 4, wherein from about 0.1 to about 10 millimoles of BF_3 are introduced into said reaction admixture with said catalyst composition for each mole of isobutylene introduced into said admixture in said feedstock.

10. A process as set forth in claim 4, wherein from about 0.5 to about 2 millimoles of BF_3 are introduced into said reaction admixture with said catalyst composition for each mole of isobutylene introduced into said admixture in said feedstock.

11. A process as set forth in claim 4, wherein the polydispersity of said mid-range vinylidene content PIB polymer composition in said product stream is no more than about 2.0.

12. A process as set forth in claim 4, wherein the polydispersity of said mid-range vinylidene content PIB polymer composition in said product stream no more than about 1.65.

13. A process as set forth in claim 4, wherein a reaction temperature of at least 90 °F is maintained in the reaction admixture while the same is recirculating in said reaction zone.

14. A liquid phase polymerization process for preparing a mid-range vinylidene content PIB polymer composition, said process comprising:

providing a feedstock comprising isobutylene;

providing a catalyst composition comprising a complex of BF_3 and a complexing agent therefor;

introducing said feedstock and said catalyst composition into a residual reaction mixture in a reaction zone;

intimately intermixing said residual reaction mixture, said feedstock and said catalyst composition to present an intimately intermixed reaction admixture in said reaction zone;

maintaining the intimately intermixed reaction admixture in its intimately intermixed condition and keeping it at a temperature of at least about 0 °C. while the same is in said reaction zone, to thereby cause the isobutylene therein to undergo polymerization to form said polyisobutylene;

withdrawing a product stream comprising polyisobutylene having an alpha plus beta isomer content of at least about 90% from said reaction zone; and

controlling the introduction of said feedstock into said reaction zone and the withdrawal of said product stream from the reaction zone such that the residence time of the isobutylene undergoing polymerization in the reaction zone is no greater than about 4 minutes.

15. A process as set forth in claim 14, wherein said polyisobutylene in said product stream has a number average molecular weight in the range of from about 350 to about 5000.

16. A liquid phase polymerization process for preparing a mid-range vinylidene content PIB polymer composition comprising PIB molecules, wherein a first portion of said PIB molecules have alpha position double bonds and a second portion of said PIB molecules have beta position double bonds, wherein said first and second portions together include at least 90% of the PIB molecules of the composition, and wherein no more than about 10% of the PIB molecules of the composition have tetra-substituted internal double bonds, said process comprising:

providing a liquid feedstock comprising isobutylene;

providing a catalyst composition comprising a stable complex of BF_3 and a catalyst complexing agent, wherein the ratio of complexing agent to BF_3 in said complex is no more than about 1.3:1;

introducing said feedstock and said catalyst composition into a residual reaction mixture in a loop reactor reaction zone;

recirculating the residual reaction mixture in said zone at a recirculation rate sufficient to cause intimate intermixing of the residual reaction mixture, the feedstock and the catalyst composition to thereby present a recirculating, intimately intermixed reaction admixture in said reaction zone;

maintaining the recirculating intimately intermixed reaction admixture in its intimately intermixed condition and removing heat of reaction from the reaction admixture at a rate calculated to provide a substantially constant reaction temperature in the reaction admixture while the same is recirculating in said reaction zone;

withdrawing a product stream comprising said mid-range vinylidene content PIB polymer composition; and

controlling the introduction of said feedstock into said reaction zone and the withdrawal of said product stream from the reaction zone such that the residence time of the isobutylene components undergoing polymerization in the reaction zone is no more than about 4 minutes.

17. A process as set forth in claim 1, wherein said feedstock comprises at least about 30% isobutylene by weight.

18. A process as set forth in claim 14, wherein said feedstock comprises at least about 30% isobutylene by weight.

19. A process as set forth in claim 16, wherein said feedstock comprises at least about 30% isobutylene by weight.

20. A process as set forth in claim 1, wherein said feedstock comprises a raff-1 stream.

21. A process as set forth in claim 14, wherein said feedstock comprises a raff-1 stream.

22. A process as set forth in claim 16, wherein said feedstock comprises a raff-1 stream.

23. A process for preparing a PIB amine compound comprising:
providing a mid-range vinylidene content PIB polymer composition comprising PIB molecules, wherein a first portion of said PIB molecules have alpha position double bonds and a second portion of said PIB molecules have beta position double bonds, wherein said first and second portions together include at least 90% of the PIB molecules of the composition, wherein said first portion includes less than 70% of the PIB molecules of the composition, and wherein no more than about 10% of the PIB molecules of the composition have tetra-substituted internal double bonds;
reacting said composition with a compound having a reactive site for subsequent amination to thereby produce an intermediate; and
reacting said intermediate with an amine.

24. A process for preparing a PIB amine compound as set forth in claim 23 wherein said compound having a reactive site for subsequent amination comprises an epoxide.

25. A process for preparing a PIB amine compound as set forth in claim 23 wherein said compound having a reactive site for subsequent amination comprises a maleic anhydride adduct.

26. A process for preparing a PIB amine compound as set forth in claim 23 wherein said compound having a reactive site for subsequent amination comprises a halide.

27. A process for preparing a PIB amine compound as set forth in claim 23 wherein said compound having a reactive site for subsequent amination comprises a carbonyl derivative.

28. A process for preparing a PIB maleic anhydride adduct comprising:
providing a mid-range vinylidene content PIB polymer composition comprising PIB molecules, wherein a first portion of said PIB molecules have alpha position double bonds and a second portion of said PIB molecules have beta position double bonds, wherein said first and second portions together include at least 90% of the PIB molecules of the composition, wherein said first portion includes less than 70% of the PIB molecules of the composition, and wherein no more than about 10% of the PIB molecules of the composition have tetra-substituted internal double bonds; and
reacting said composition with maleic anhydride.

29. A process for preparing a PIB maleic anhydride adduct comprising:
providing a mid-range vinylidene content PIB polymer composition comprising PIB molecules, wherein a first portion of said PIB molecules have alpha position double bonds and a second portion of said PIB molecules have beta position double bonds, wherein said first and second portions together include at least 90% of the PIB molecules of the composition, wherein said first portion includes less than 70% of the PIB molecules of the composition, and wherein no more than about 10% of the PIB molecules of the composition have tetra-substituted internal double bonds; and
reacting said composition with a phenolic compound.